

Long-term physical and psychological effects of the Vajont disaster

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Background: Few studies to date investigated the long-term consequences of disasters on physical health.

Objective: The aim of the present report was to study the consequence on physical health of exposure to the Vajont disaster after 40 years. We also explored the effects of severity of trauma, posttraumatic stress disorder (PTSD), and major depression disorder on physical health and health-related quality of life.

Method: Sixty survivors of the Vajont disaster and 48 control subjects of similar gender, education, and age participated in the study. Physician-reported and subjective measures of physical health have been employed.

Results: Survivors reported a greater number of physical complaints than controls ($p < 0.001$), and some type of diseases showed a significant relationship with PTSD or PTSD symptoms. Quality of life differed between the two groups as regards the perception of physical health. The number of intrusive PTSD symptoms showed a significant negative effect on the quality of life of survivors.

Conclusions: Our study shows that large-scale disasters such as the Vajont one may have deleterious effects on both psychological and physical health.

Keywords: *PTSD; physical health; disaster; major depression*

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Several studies have demonstrated that extreme traumatic events have deleterious effects on both the psychological and physical health of the survivors (Anda et al., 2006; Felitti, Anda, Nordenberg, & Williamson, 1998; Schnurr, 1996; Van den Berg et al., 2008). According to some authors (Engelhard, Van den Hout, Weerts, Hox, Van Doornen, 2009; Lauterbach, Vora, & Rakow, 2005; Spitzer et al., 2009), the effects on physical health are mediated by the development of a psychiatric disturbance, such as posttraumatic stress disorder (PTSD) or depression. Only long-term studies allow the full understanding of these effects because only when subjects are at a high-risk age for a particular medical condition, the additive effects of traumatic stress can be measured (Ford et al., 2004). The aim of our study was to assess the long-term effects on psychological and physical health of surviving to the Vajont disaster in a group of survivors compared with a non-exposed control group of similar age and gender.

The Vajont disaster happened on October 9, 1963, at 10.39 pm., when a 266 million cubic meters rockfall slid into the lake formed by the Vajont dam, in the north east of Italy (Favaro, Zaetta, Colombo, Santonastaso, 2004). The rockfall, moving at the speed of approximately 90 kph, displaced about 50 million cubic meters of water that poured down into the valley. In a few minutes, the enormous wave completely destroyed the village of Longarone and many other small villages causing 1,910 deaths. The energy released has been estimated to be similar to that of an atomic bomb explosion. About 446 bodies were never recovered and another 761 never identified. The dam survived the disaster in perfect condition. Unfortunately, the project was based on a completely defective geological assessment of the solidity of the mountain slopes overlooking the lake. Longarone had to be completely rebuilt, whereas other small villages were abandoned. Very few of those who were in the very place where the tidal wave passed survived. Most of them

lost all their family and belongings. Other people living in the destroyed villages survived because they were not at home at the time of the disaster. In a previous article (Favaro et al., 2004), we have described the psychological effects of the different types of exposure to the disaster and we found that direct exposure to the wave caused the highest risk for PTSD, whereas the loss of family members had a significant relationship with the development of Major Depression. These findings were similar to those of a previous study on a comparable disaster (Gleser, Green, & Winget, 1981).

Methods

The study was performed as a result of the collaboration of the Vajont Survivors Association that made available a list of survivors. All the subjects were invited by letter to take part in the study and were later contacted by phone to arrange for their participation. All subjects were interviewed face-to-face and gave written informed consent for the use of data in an anonymous form. Clinical interviews were recorded on tape and lasted about 2 hours. The interviews were performed from April 2005 to October 2007 (42–44 years after the disaster).

The presence of PTSD and major depression disorder was determined using the Structured Clinical Interview for DSM-IV. A semistructured interview investigated the severity of the traumatic experience and the physical health status. We asked survivors to describe their experience, also specifying the loss of loved ones, the loss of personal belongings, the extent of financial damage, as well as any physical injuries. In addition, patients were asked if they suffered from a detailed list of medical conditions, about the number of visits they had in the last year by their general practitioner, and the number of admissions. After a written permission was obtained, the general practitioner of every participant in the study was contacted and interviewed about the general health of the subject. We prepared a structured schedule to investigate the presence of a series of physical problems. The investigated problems were cardiovascular, respiratory, endocrinological, dermatological, gastroenterological, rheumatological, neurological and psychiatric diseases, any type of cancer, and any type of pain syndrome. The general practitioner received a short training about the schedule and then compiled the schedule with the patients, using the available documentation, including data about number of hospital admissions and outpatient visits in the last year. Practitioners had to indicate the type of illness (in the lifetime), if the illness is still present, the age of onset, the therapy, and if therapy was beneficial or not.

We used the Multidimensional Scale of Perceived social Support Scale in order to assess perceived social support

after disaster (Zimet, Powell, Farley, Werkman, & Berkoff, 1990).

We contacted 123 survivors, but 63 refused to be interviewed. Reasons for refusal were unable to take part because of lack of time ($n=16$), health problems ($n=7$), not in a psychological state to be able to speak about the disaster ($n=30$), not interested in the study ($n=6$), and not living in the valley during the disaster ($n=4$). The total response rate was 49%. For the aims of this study, we recruited subjects who did not experience a direct physical damage at the time of the disaster in order to disentangle the direct physical damage caused by the disaster from the long-term effects on health.

The sample of survivors was composed of 60 subjects, 22 women and 38 men, with a mean age of 63.0 years (SD 7.5; range 49–79; no differences between genders). Mean age at the time of the disaster was 20.7 years (SD 7.6; range 6–35). The mean number of years of education was 8.9 (SD 3.5). Six subjects who participated in the present study also participated in our previous study (Favaro et al., 2004).

The control group was recruited among the patients of similar age of a general practitioner in a village of the near geographical area, not involved in the disaster. We excluded 12 subjects who reported some severe traumatic experience (natural disaster or personal violence). The final sample of controls is composed of 48 subjects, 24 women and 24 men with a mean age of 64.5 years (SD 7.5; range 52–79). No differences between survivors and controls emerged as regards age, gender, years of education, and socioeconomic status. The control group did not undergo a structured diagnostic interview for the assessment of PTSD and Major Depression. Their general practitioner completed the same schedule used for the survivors sample. Both groups (survivors and controls) completed the Short Form 36 Health Survey Questionnaire (SF-36; Ware, 1993).

Statistics

The SPSS software was used. Given the nature of our variables (“count” variables), non-parametric statistical tests (Mann–Whitney U-test with z approximation) have been used to test differences in number of symptoms/admissions/physical complaints. Crude odds ratios (ORs) with 95% confidence intervals were used as measures of relative risk, and logistic regression analysis was performed when covariates are included in the model as nuisance variables. Multiple regression models were used to explore the relationship between the number of physical complaints (Poisson regression) or health-related quality of life (linear regression) and other variables.

Results

A significantly higher number of medical conditions have been reported in the group of survivors compared to the

control group (3.3 ± 1.7 vs. 2.1 ± 1.2 ; Mann–Whitney U-test: $z = 3.65$; $p < 0.001$), but we found no differences in the number of visits or admissions in the previous year. In particular, survivors of the Vajont disaster reported a higher number of gastrointestinal diseases, dermatological problems, respiratory diseases, and a miscellanea group, including neurological, rheumatological, and ophthalmological problems (Table 1). Lifetime smoking (lifetime maximum number of cigarettes per day: 7.5 ± 13.3 vs. 11.0 ± 14.0 ; Mann–Whitney U-test: $p = 0.192$; and, smoking more than 15 cigarettes for at least 1 year: 23% vs. 38%; $\chi^2 = 1.04$; d.f. = 0 1; $p = 0.309$) was not associated with the presence of respiratory diseases in the survivors group.

Using a Poisson regression analysis, we found that loss of loved ones before the disaster (Wald $\chi^2 = 6.41$; df = 1; $p = 0.011$) and lacking social support after the disaster (Wald $\chi^2 = 9.36$; df = 1; $p = 0.002$) were significant predictors of the number of physical complaints, controlling for the effects of age, gender, and education (Omnibus test for the model: $\chi^2 = 11.54$; df = 5; $p = 0.042$).

To evaluate the influence of the severity of trauma exposure on the physical health, we studied the effects of: (1) being present at the time of the disaster; (2) loss of first degree relatives; and (3) very severe economic loss. None of these factors was significantly associated with the number or type of physical diseases, using Poisson regression models ($p > 0.5$).

We then explored the relationship between physical health in survivors and presence of PTSD and/or Major Depression. Six survivors (10%) reported a lifetime diagnosis of PTSD, and 11 (18%) a lifetime Major Depression. Lifetime partial PTSD (at least one symptom in any of the three clusters) was present in 25 survivors (42%). Survivors with lifetime PTSD tend to suffer more often from cancer (50% vs. 15%; OR = 5.8; 95% CI, 1.0–33.6; $p = 0.05$) and the association was significant even after controlling for age, gender, and body mass index using a logistic regression analysis. On the contrary, the presence of Major Depression (current or in the

lifetime) was not associated with a greater number of physical conditions or with specific somatic diseases. When the presence of specific PTSD clusters of symptoms was considered instead of the whole syndrome, we found a significant association between genitourinary diseases and avoidance PTSD symptoms (OR = 6.0; 95% CI, 1.2–28.7; $p < 0.03$) and between cardiovascular diseases and hyperarousal PTSD symptoms (OR = 3.4; 95% CI, 1.0–11.4; $p < 0.04$). No relationship emerged between the presence of PTSD/depression and health services utilization in our sample of survivors.

Finally, we explored difference between survivors and controls as regards quality of life, measured by means of the SF-36 scale. We did not find a significant difference between survivors and controls as regards quality of life, with the exception of the subscale about “physical role” (68.6 ± 41.6 vs. 47.9 ± 43.4 ; $z = 2.46$; $p < 0.02$). A multiple regression analysis was performed in the survivors group to explore the effects of PTSD and depression symptoms on quality of life, controlling for age, gender, and education. The analysis revealed a significant independent negative effect of the number of intrusive symptoms ($\beta = -0.34$; $t = 2.51$; $p = 0.016$), and of depressive symptoms ($\beta = -0.34$; $t = 2.56$; $p = 0.014$). The model including these two clusters of symptoms and the covariates explained about 18% of the total variance (adjusted R-squared = 0.18; model $F(5,44) = 3.22$; $p = 0.015$). No significant effect emerged in a similar analysis performed to explore the effects on quality of life of being present at the time of the disaster, loss of first-degree relatives, and economic damage.

Discussion

Our study found evidence that extreme traumatic events, such as the Vajont disaster that happened in 1963, may impact not only the psychological well-being of survivors but also their long-term physical health. These effects are not due to a “direct” effect of the trauma on the body integrity because we excluded all subjects who were physically injured at the time of the disaster. Our study shows that many types of physical problems are more

Table 1. Frequency of physical conditions reported by survivors and controls

Physical diseases	Survivors (N = 60) N (%)	Controls (N = 48) N (%)	OR (95% CI)
Cardiovascular	18 (30)	8 (17)	2.1 (0.8–5.5)
Hypertension	29 (48)	28 (58)	0.7 (0.3–1.4)
Gastroenterological	27 (45)	10 (21)	3.1 (1.3–7.3)
Dermatological	11 (18)	2 (4)	5.2 (1–24.5)
Any pain syndrome	40 (67)	26 (54)	1.7 (0.7–3.6)
Cancer	11 (18)	4 (8)	2.5 (0.7–8.3)
Respiratory	21 (35)	3 (6)	8.1 (2.2–29.1)
Genitourinary	9 (15)	10 (21)	0.7 (0.2–1.8)
Endocrinological	16 (27)	9 (19)	1.6 (0.6–3.9)
Others (neurological rheumatological, ophthalmological)	17 (28)	2 (4)	9.1 (1.9–41.7)

frequent among the survivors than among a group of control subjects with similar age, gender, and education. The difference was significant in particular for respiratory diseases and a miscellanea group of illnesses that included neurological, rheumatological, and ophthalmological problems.

In addition, our data seem to add evidence to the hypothesis that, for the development of some physical medical conditions, posttraumatic stress disorder and social support might play a contributing role (Favaro et al., 2011; Friedman & Schnurr, 1995; McFarlane, Atchison, Rafalowicz, & Papay 1994; Wagner, Wolfe, Rotnitsky, Proctor, & Erickson, 2000; Wolfe, Schnurr, Brown, & Furey, 1994). The finding that survivors with PTSD suffered from cancer more often than survivors without PTSD should be considered with caution because of the small sample size of survivors with PTSD diagnosis (only six). In addition, a cancer diagnosis could represent an additional traumatic event that could increase the risk of displaying PTSD symptoms (Peretz, Baider, Ever-Hadani, & De-Nour, 1994). Our study did not find an association between PTSD and other medical conditions such as cardiovascular, autoimmune, respiratory, muscular skeletal, and neurological diseases (Lauterbach et al., 2005; McFarlane et al., 1994; Ouimette et al., 2004; Spitzer et al., 2009).

The presence of major depression was not associated with a greater number of physical conditions or with specific somatic diseases; therefore, our study does not support a role of depression as predictor of physical outcome (Morina, von Lersner, & Prigerson, 2011) in our group of aged survivors. However, the findings of our study are difficult to be compared with previous reports because only few studies explored long-term consequences on physical health of natural/technological disasters or other type of trauma (Sharon, Levav, Brodsky, Shemesh, & Kohn, 2009).

When PTSD symptoms were considered instead of the whole syndrome, we found a significant association between cardiovascular diseases and hyperarousal PTSD symptoms. This association gives some support to the hypothesis that hyperarousal and noradrenergic hyperactivity might play a role as cardiovascular risk factors, as reported in other studies (Boscarino, 2008; Boscarino & Chang, 1999; Del Villar, Alonso, Feldstein, Juncos, & Romero, 2005; Heim, Ehler, & Hellhammer, 2000; Kubzansky, Koenen, Spiro, Vokonas, & Sparrow, 2007; Wilbert-Lampen et al., 2006).

Differently from other studies (Deykin et al., 2001; Schnurr, Friedman, Sengupta, Jankowski, & Holmes, 2000), in our sample, a relationship between PTSD/depression and health services utilization did not emerge. In addition, although they have a significantly higher number of physical problems, survivors showed levels of health services utilization that are similar to those of

control subjects. This phenomenon can be due to specific cultural factors that might enhance the avoidant behavior that is typical of traumatized subjects.

Even after 40 years from the disaster, health-related quality of life of survivors is significantly influenced by psychiatric problems (Guan, Deng, Cohen, & Chen, 2011), and in particular by the number of intrusive PTSD symptoms and by depression.

The present study is one of the few long-term investigations about the impact of extreme trauma on physical health. Differently from most similar studies, we have employed both practitioner-reported and subjective (SF-36) measures of physical health. However, our study also has important methodological limitations that could impair the generalizability of our findings. The frequencies and differences among the different medical conditions should be considered with caution because of the small sample size. In addition, our sample cannot be considered representative of the disaster survivors because a methodological bias exists in our recruitment procedure. The main reason of bias is the absence of an official list of the Vajont disaster survivors and the fact that many survivors of the Vajont disaster never returned to the scene of the disaster. The response rate is not lower than that of similar studies, but the main reason for refusal was the inability to speak about the event. This led to underestimated PTSD and depression rates. Finally, another source of possible bias is the sample attrition due to the time which has elapsed since the trauma.

Our study is one of the few long-term follow-up (more than 40 years) exploring the impact of disasters on health. It shows that large-scale disasters such as the Vajont one may affect the psychological and physical health of survivors for decades. These effects do not seem to be related to direct effects of trauma or to the degree of exposure. The study shows the role of PTSD or symptoms of PTSD and social support as possible contributing factors in the health outcome. The trauma consequences, in particular intrusive PTSD symptoms and depression, have an important impact on the Vajont survivors' quality of life.

Conflict of interest and funding

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